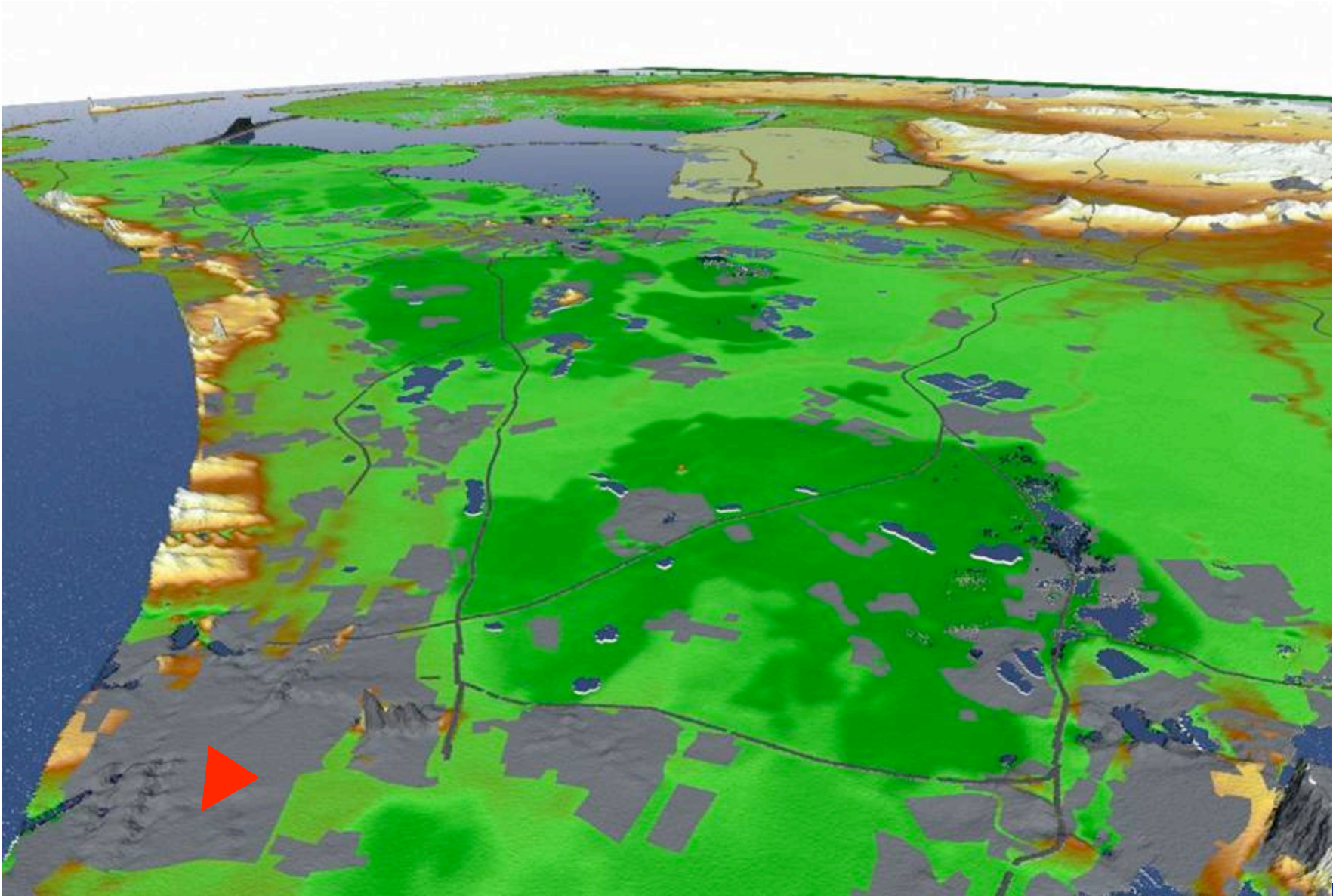
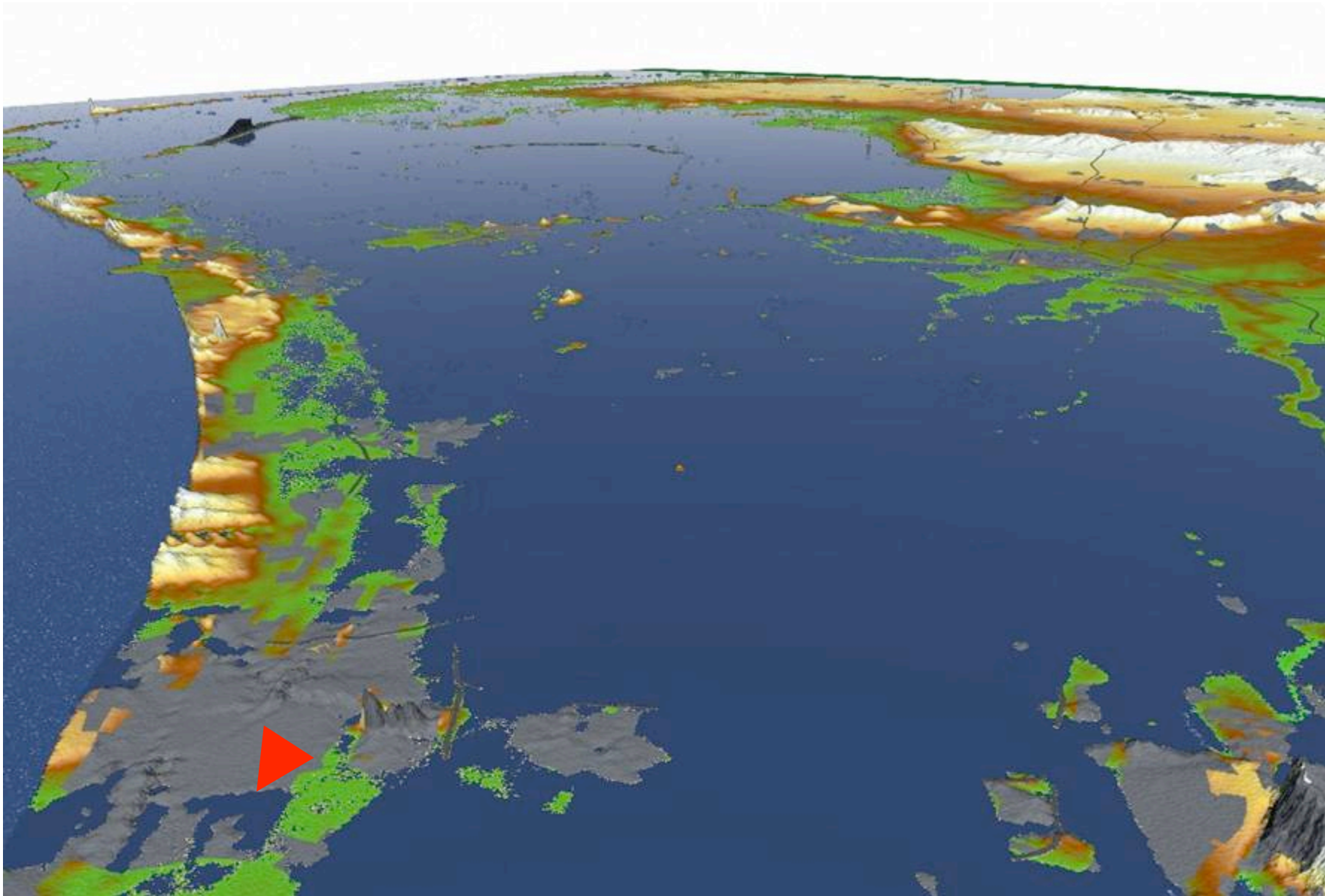


Netherlands today



The Netherlands according to ICCP



TNO - Netherlands Organisation for Applied Scientific Research



*TNO Built Environment
and Geosciences*

*TNO Science
and Technology*

*TNO Quality of
Life*

*TNO Defence,
Security and
Safety*

*TNO Information
and
Communication
Technology*

TNO

- One of the largest – fully independent – R&D-companies in Europe
- A public enterprise founded by law in 1932
- Ca. 4700 employees
- Annual turnover: 562 million EURO (2005)
- Covering a wide range of technologies

mission statement

To apply scientific knowledge with the aim of strengthening the innovative power of industry and government

by

- Developing fundamental knowledge in cooperation with universities
- Developing applied knowledge with partners and customers
- Exploration of knowledge-basis

TNO's five core areas



TNO Quality of
Life



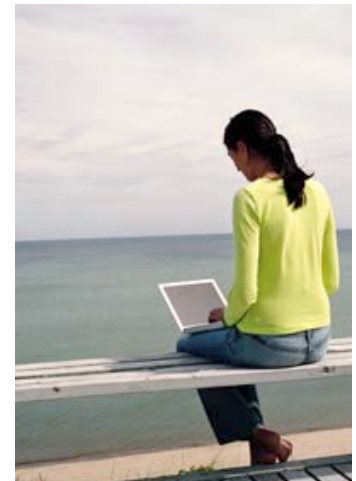
TNO Defence,
Security and
Safety



TNO Science
and Technology



TNO Built
Environment
and
Geosciences



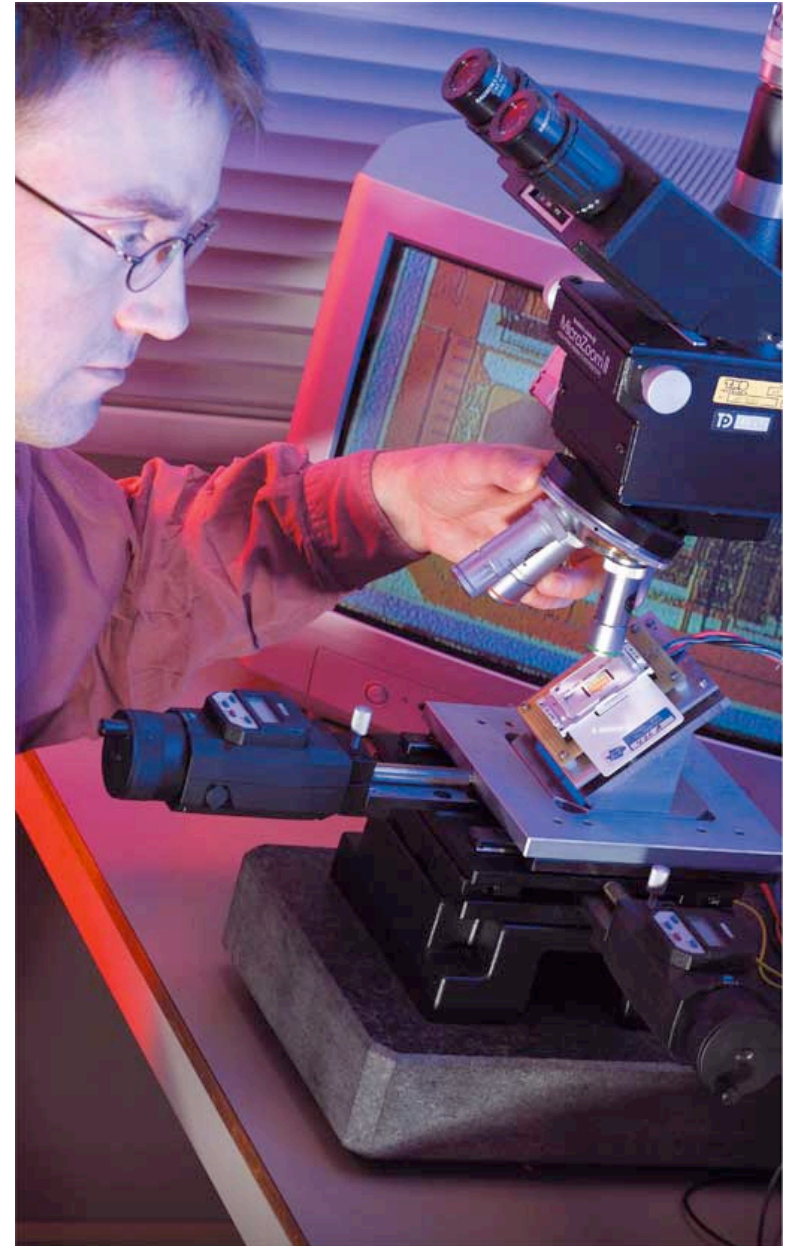
TNO Information
and
Communication
Technology

TNO's mission

TNO's mission is to apply scientific knowledge with the aim of strengthening the innovative power of industry and government.

You can engage TNO for:

- *Consultancy* on policy and improvements to products and processes;
- *Contract research* on behalf of public authorities, companies and organisations;
- The performance of *tests* and the *certification* of products and systems;
- Acquiring *licences* for any of TNO's 450 inventions.



TNO Built Environment and Geosciences

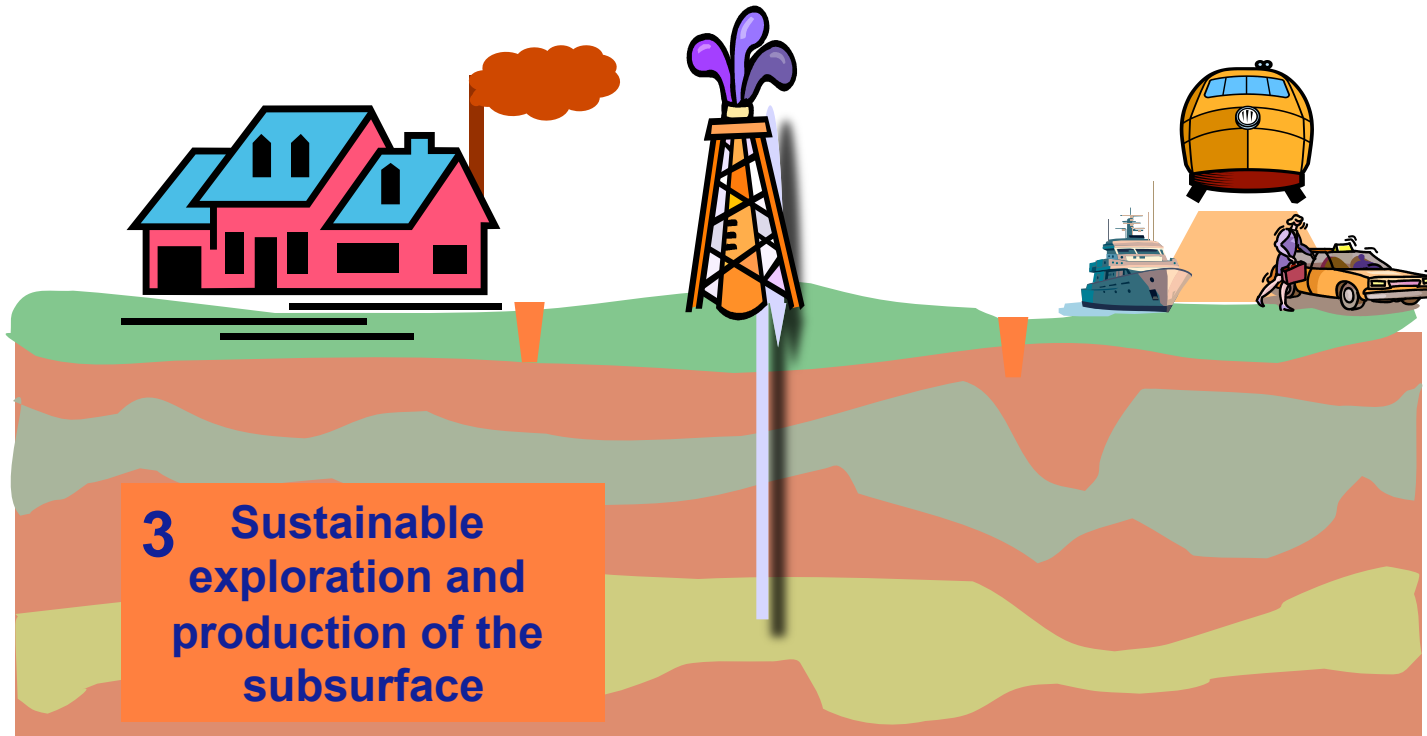
The innovative partner for government and industry for sustainable organisation, use and management of the built environment, infrastructure and subsurface



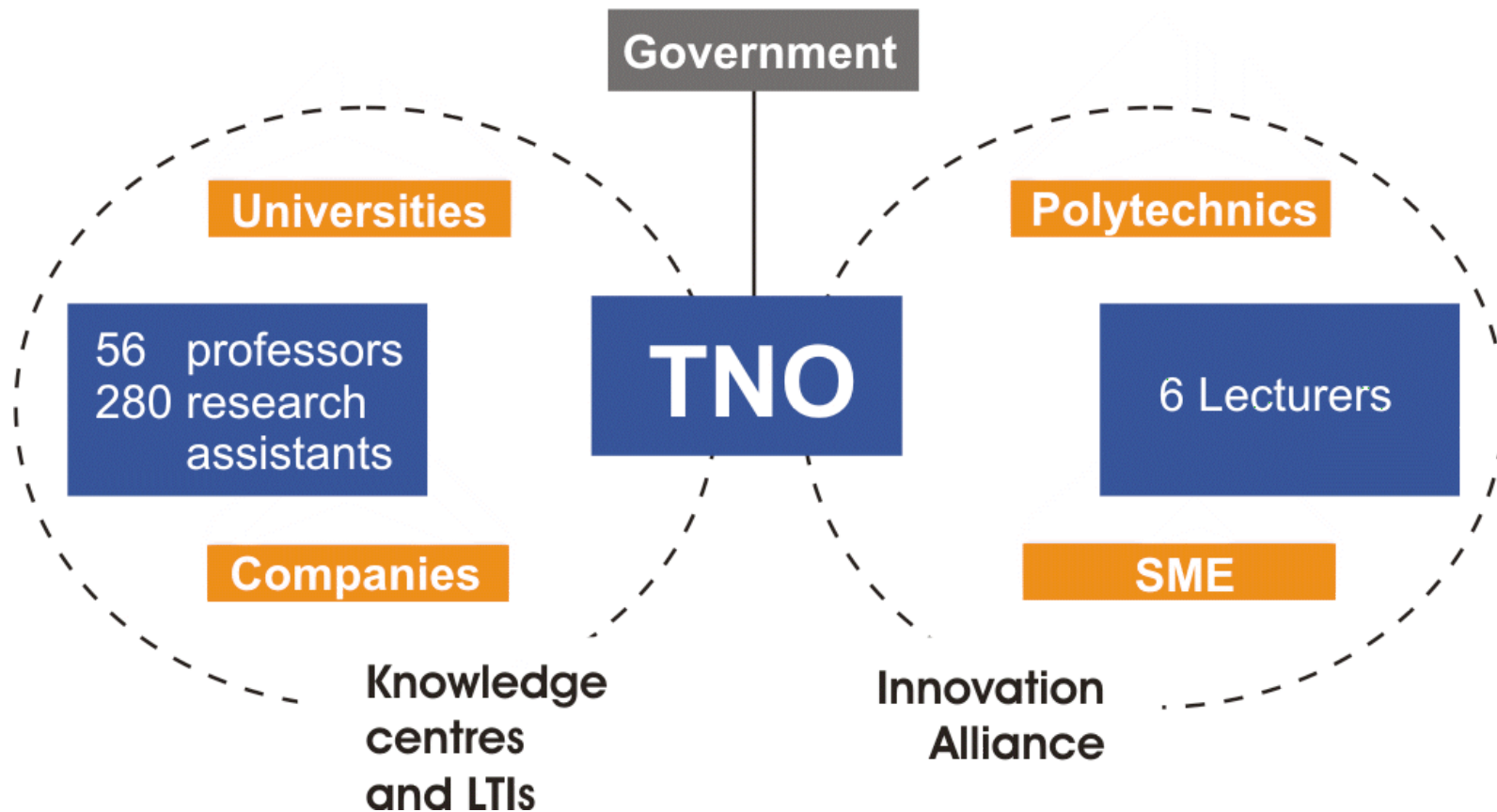
Areas of application

**1 Sustainable construction/
management of built
environment**

**2 Sustainable use/
management of
infrastructure**

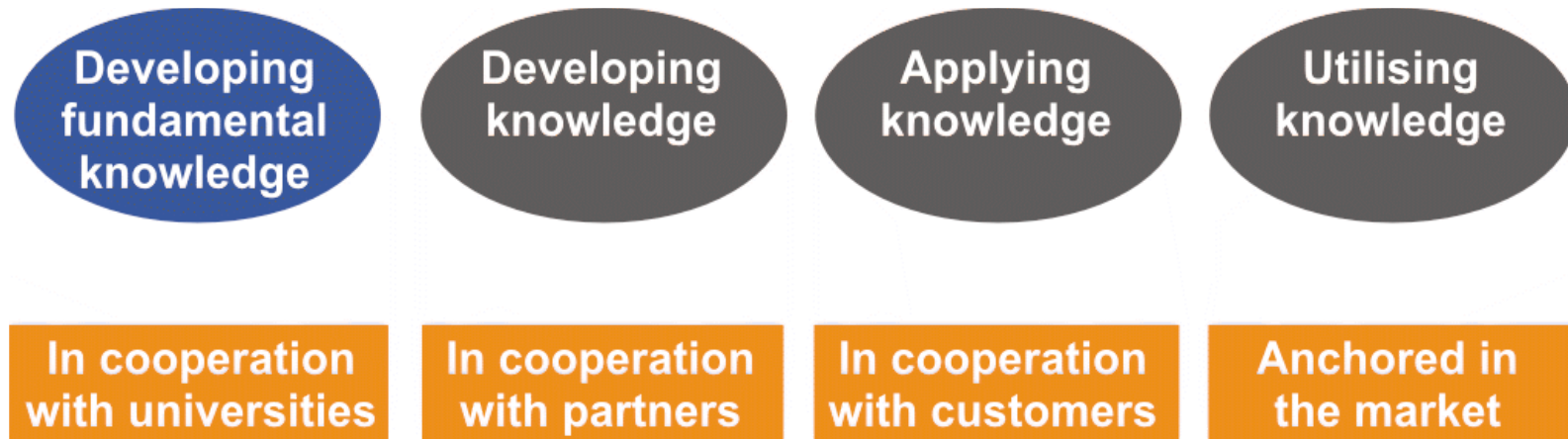


TNO in the knowledge infrastructure



The strength of TNO

From concept to innovation





BU Buildings and Systems

Departments:

- Energy, Comfort and Indoor Environment
- Heating and Refrigeration
- Building Systems and ICT
- Innovative Building Materials

Support area's:

- Indoor climate: healthy, comfortable and energy efficient
- Innovative (building) materials
- Development integrated building systems
- Introduction new maintenance strategies
- Optimization collaboration processes and ICT

Approach: coherent set of measures



Ambition:

Development of technologies and methods that will enable an energy producing built environment.

One of the essential boundary conditions is a comfortable, healthy indoor environment and sustainable use of materials.

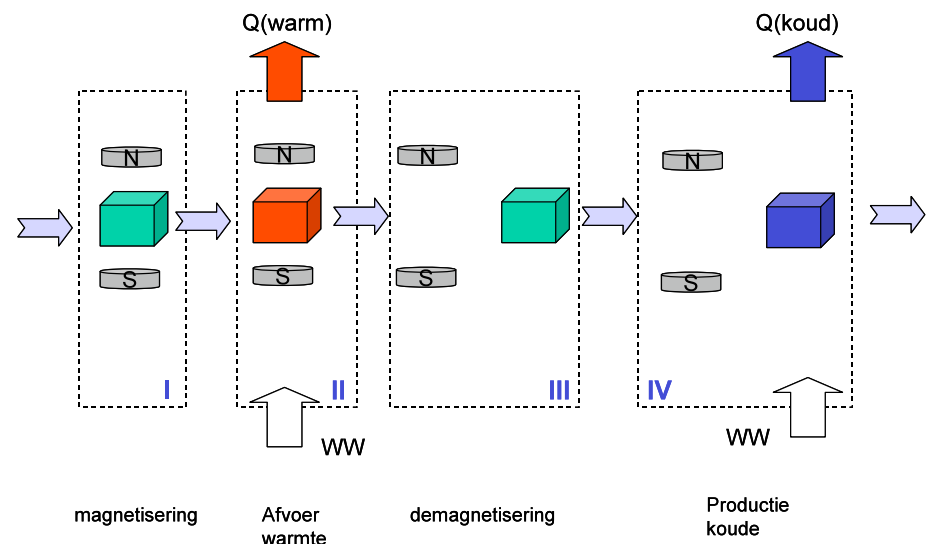
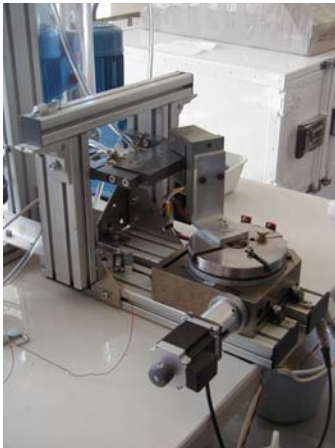


Research topics (Energy, Comfort and Indoor Environment)

- **Energy**
 - Ventilation
 - Thermal storage
 - Heating and Cooling
 - Magneto caloric
 - Miniaturisation conventional technologies
 - Heat pumps and heat transfer
- **Indoor Environment**
 - Source control
 - Indoor Environmental Quality (thermal, visual, odors, VOC)
 - Biosensing
- **Performance of buildings and systems**
 - Standards, regulations and labels
 - Cx, Sustainable management and maintenance

Existing buildings

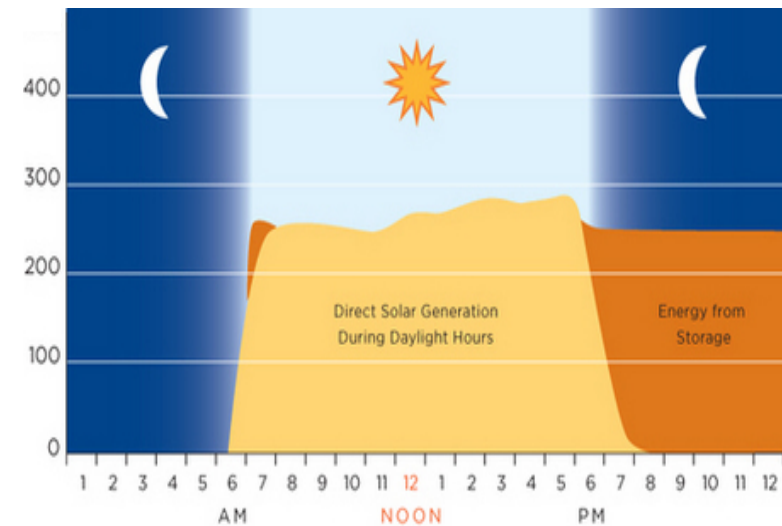
- Magnetocaloric
 - Decentral, quiet, compact, E-eff., no refrigerants
- Miniaturisation
 - Compact, natural refrigerants



Integration renewable energy

Thermochemical storage

- Bridging mismatch demand and supply
- Seasonal and daytime storage
- Integration in buildings



Energy efficiency 'in use'

Intelligent operation and maintenance of buildings and installations

Results of a TNO survey of 70 buildings showed:

i-BIG

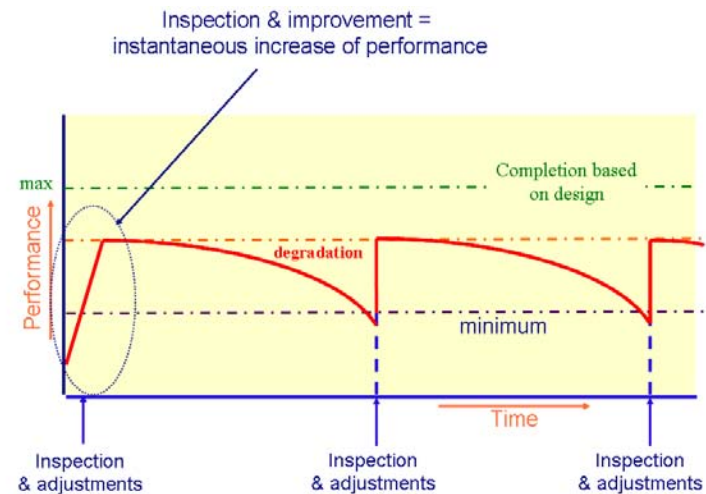
The most common complaints are related to comfort and high energy consumption

Problems:

- a) The average energy use of buildings is **25%** higher as expected
- b) **70%** of the HVAC systems do not work as expected
- c) **90%** of the comfort problems can be attributed to inappropriate working of the HVAC system

Causes:

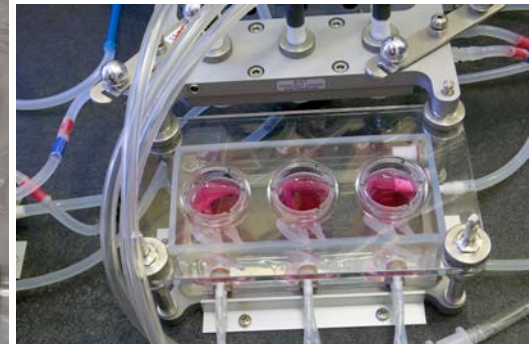
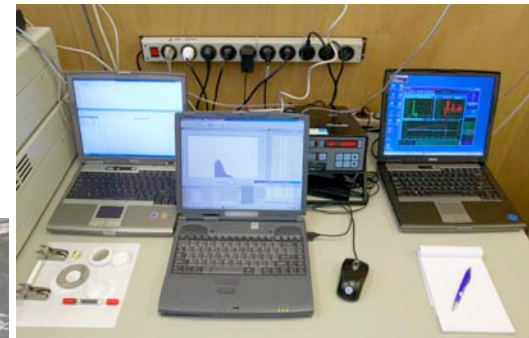
- a) 15% design faults
- b) 85% (i) completion (handover) of HVAC system and (ii) maintenance



Comfort, health and indoor environment

Biosensing

- Cultex combined with Ames





EPBD The Energy Performance of Buildings Directive

Content:

- From national to European perspective
- Current challenge: European versus national
- New: from European to global perspective



Field experiment: Productive office personal comfort

- Radiation heating, nozzles, daylight, light colour, ventilation



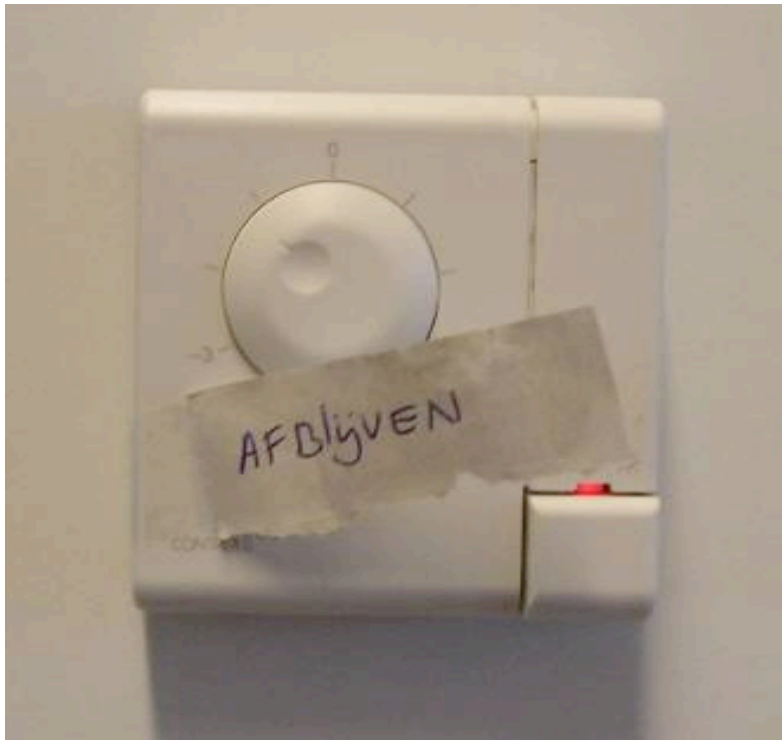
Adjustement possible

- parameters
 - light
 - heating
 - cooling

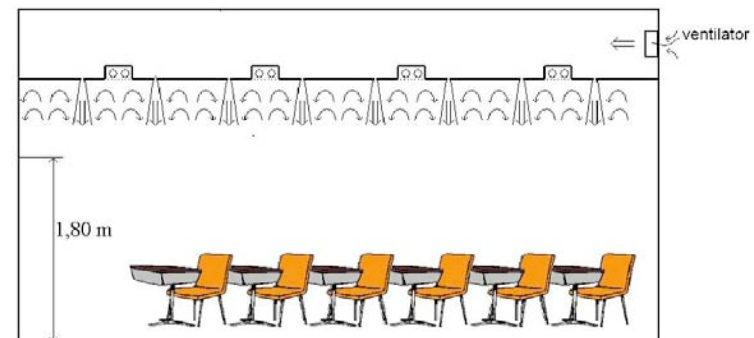
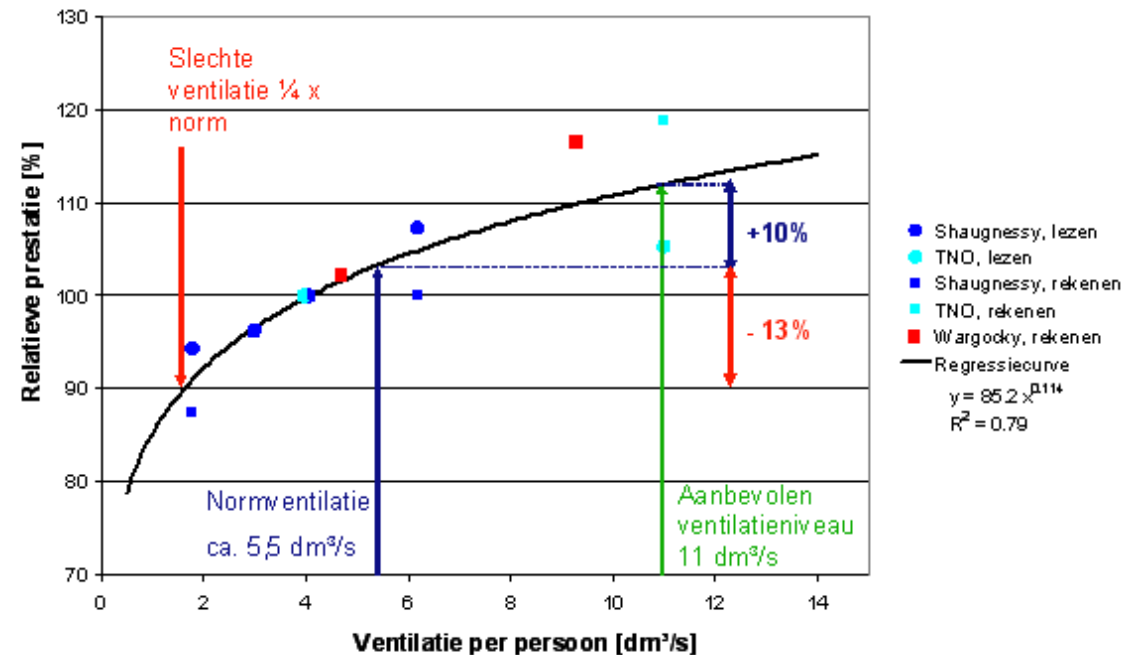


User interface

- User interaction is a key issue



Improved performance in existing buildings: Fresh Schools



Districts: Sun city







Universal clip for pv panels



Endresult city of the sun, Location Heerhugowaard, Part 1



Endresult City of the sun, Location Heerhugowaard, Part 1

Building type E
5.440 Wp



Endresult city of the sun, Location Heerhugowaard, Part 1

Woning type A
3.400 Wp



Part 2 in progress



Field experiment:
districts

Real-time
Full scale
Exp.

Lab-scale
Exp.

Lab. TNO

Ambition

Database TNO
(experimental &
Cons. behaviour)

- ▶ Data consumer behaviour and actual performance
- ▶ Finetuning rules and regulations
- ▶ Feasibility studies
- ▶ New technological concepts
- ▶ Sensibility analyses District level
- ▶ Validation models and software
- ▶ Effect and impact measurement Rules/regulations



Innovation is mostly created at the interface
where different worlds touch.

Strategic Plan TNO 2007-2010